ABSTRACT

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The Atmospheric Infrared Sounder on EOS

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The Atmospheric Infrared Sounder (AIRS) is a facility instrument on the Earth Observing System (EOS) P.M. platform. It will be launched into a 705 km high polar orbit in the year 2000. On the platform with AIRS are the Advanced Microwave Sounding Unit (AMSU) and the Microwave Humidity Sounder (MHS). The three instruments are designed to meet NASA's global change research objectives and NOAA'S operational sounding requirements for global weather predictions. AIRS, AMSU and MHS will provide global temperature profiles with 1K rms accuracy in 1 km thick layers in the troposphere and water burden with 10% accuracy. This is more than a factor two better than the current operational sounding system, TOVS, and is expected to result in a significant improvement in the medium range forecast accuracy.

AIRS is a g]-sting array infrared spectrometer which produces a spectrum with spectra] resolution of 1200 from 3."/ to 15.4μm for each 1.1 degree diameter footprint. A rotating scan mirror creates a ±49 degree wide footprint swath perpendicular to the spacecraft ground-track for twice daily coverage of almost the entire globe. The high performance of AIRS is largely the result of recent breakthroughs in infrared detector array and active cryocooler technologies. AIRS uses 15 linear arrays. The arrays and the read-out devices are arranged in a focal plane measuring only 8 by 37

mm. The spectrometer optical bench is cooled to 155K with a passive radiator, to decrease the background flux on the detectors. The focal plane is cooled to 60K using an active refrigerator with redundant dual compressor/expanders to insure a five year lifetime. The 60 K temperature allows the detectors to perform close to background photon noise limited. The focal plane is mounted inside a sealed dewar to virtually eliminate contamination by condensibles in orbit. Spectra taken by AIRS are calibrated and inverted to temperature and moisture soundings in the data processing system on the ground.

The prototype retrieval algorithms for the ground data processing system are developed by the AIRS science team and optimized and integrated into the EOS data product generation system by a team of software engineers. Upwelling radiance spectra generated from mesoscale temperature and humidity profile models are used to simulate the data from AIRS, AMSU and MHS. The simulation is used to develop the retrieval algorithm. The simulations use nominal instrument characteristics. The simulated data include wavelength dependent emissivity and reflectivity of the surface. Under cloud-free conditions we have by now demonstrated that algorithms using physical relaxation, statistical physical retrieval and neural networks can meet the accuracy requirements. The algorithm concept for retrievals under partly cloudy conditions uses a combination of AIRS and AMSU data. It builds on the experience with the current operational sounding system. Algorithm development to handle partially cloudy conditions is starting. The selection of the complete retrieval software package will occur by late 1996.

Keywords: Remote sensing, Satellite, Temperature Sounding, Moisture Sounding, Infrared, Grating, Spectrometer